R E P O R T R E S U M E S

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TEACH THEM TO LIFT. SAFETY IN INDUSTRY--MECHANICAL AND PHYSICAL HAZARDS SERIES.

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BASIC LIFTING TECHNIQUES TO HELP PREVENT INJURIES TO WORKERS ARE DESCRIBED AND ILLUSTRATED IN THIS BULLETIN. TEACHING TECHNIQUES ARE SUGGESTED. ONE SECTION INCLUDES A "DO-IT-YOURSELF" PROJECT CONTAINING PLANS AND INSTRUCTIONS ON HOW TO BUILD A "HOW TO LIFT MODEL" WHICH CAN BE USED AS AN ECONOMICAL VISUAL TRAINING AID. PRINCIPLES OF SAFE LIFTING INCLUDE -- (1) CARRY THE LOAD CLOSE TO THE BODY, (2) KEEP THE BACK AS STRAIGHT AS POSSIBLE, (3) LIFT WITH THE LEG AND ARM MUSCLES, (4) HAVE A CLEAR VISION OVER THE LOAD, (5) GET HELP IF THE LOAD INTERFERES WITH NORMAL WALKING, (6) NEVER BE AFRAID TO ASK FOR HELP, (7) BRING IN SUGGESTIONS WHEN YOU THINK SOME TYPE OF MECHANICAL EQUIPMENT WILL DO A BETTER JOB, AND (8) HOUSEKEEPING IS IMPORTANT. THIS REVISION WAS PREPARED IN THE OFFICE OF OCCUPATIONAL SAFETY, DIVISION OF PROGRAMING AND RESEARCH. THE DOCUMENT SIZE IS 6 BY 9 INCHES. IT IS ALSO AVAILABLE AS GPO L16.3--110 FOR 15 CENTS FROM SUPERINTENDENT OF DOCUMENTS, U.S. GOVERNMENT PRINTING OFFICE, WASHINGTON, D.C. 20402. (PS)

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SAFETY IN INDUSTRY

MECHANICAL AND PHYSICAL HAZARDS SERIES

teach them to lift

[redacted]

U.S. DEPARTMENT OF LABOR
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CONTENTS

	Page
Manual Lifting Problem	1
Searching for a solution	1
Legislation	1
Federal	1
State	1
Complexities of the problem	2
Worldwide (manual lifting) concern	3
Setting the limits	3
Male worker	4
Women workers and boys	4
Girls	4
Department's position: caution	4
Nutritional problems	4
Physical conditions	5
Climatic conditions	5
Definition of task	5
World War II standards . . . obsolete	5
Teach them to lift	6
Demonstration model	6
Teach Them How To Lift	7
Pick it up—put it down	7
Here's help for you	7
Why do it the hard way?	8
Get these facts in mind	9
Workers must be trained in safe lifting	9
Mechanical devices promote safety where the load is great	9
There are limits to the weights each person can lift safely	9
Never overestimate the power of a woman	10
Job placement, too	10
Teamwork takes practice	11
There is a proper position for lifting heavy objects	11
Analyze before you start	11
Call your group together for training	12
Describe plant experiences	12
Try this experiment	12

	Page
Demonstrate the proper way to lift	13
It all adds up to . . .	13
How To Build a Demonstrator "How To Lift Model"	15
How To Build It	16
Parts List	16
Materials List	17
Instructions	19
How To Demonstrate It	21
Incorrect Lifting	21
Correct Lifting	22
Chart Illustrating States With Protection for Worker on Manual Lifting and Carrying of Weights	C3

Safety in Industry

MECHANICAL AND PHYSICAL HAZARDS

TEACH THEM TO LIFT

Manual Lifting Problem

Searching for a solution

THE problem of injuries resulting from the manual handling of materials continues to plague industry. The accident preventionist still seeks to reduce the toll of this type injury by setting broad brush restrictions on how much a person should be permitted to lift. The Bureau frequently receives requests from many quarters (industry, labor, and Federal and State Governments) for Federal regulations which set a limit on how much a person, male or female, can be expected to lift. Everyone is searching for a solution. Many are seeking that one magical "cook-book" formula to solve all of their manual lifting and carrying problems. Unfortunately, there is no easy way out.

Legislation

- **Federal**

There are no Federal regulations that set limits on the amount of weight one person may be permitted, or required, to carry, lift or handle.

- **State**

There are over 20 States that carry some degree of coverage with respect to laws, rules, regulations that limit the amount one person may be required to lift or carry. The rules vary within each State

and, therefore, one should be familiar with the laws of the State involved before attempting to write any rules on lifting or carrying. Most of the laws cover minors and female employees. The following list provides a capsule description of the lifting and carrying restrictions one may find in the States regulating this activity.

1. Collectively, there are some 18 States that provide lifting and carrying protection for minors.
   a. Five States at present limit the amount of weight a *minor* (male) may be required to lift.
   b. At present, 13 States prohibit *minors under 16 years of age* from engaging in "heavy" work in the building trades. Kentucky prohibits "heavy" construction work for *minors under 18 years of age.* (No specific weights given.)
2. Thirteen States limit the amount of weight *female employees* may be required to lift or carry.
3. Two States limit the amount of weight *any person* may be required to carry.
4. Three States prohibit *men* and *women* from lifting and/or carrying heavy weights.

It is particularly interesting to note that the age range for minors runs from 14 to 18 years of age. The range on the average amount of weight permitted to be carried ranges from 10 to 60 pounds.

Complexities of the problem

Few people appreciate the complexities of the overall lifting problem. It is noted with considerable concern that the majority of the inquiries pertain to only the weight-lifting limitations. Little if any concern is expressed about the other aspects of the problem, i.e., how much, how often, how far, how high, or for how long a period of time the weight is to be carried or handled. A typical inquiry is quoted verbatim, "I should like to know if there are rules or regulations . . . the amount of weight a person should lift while working in a factory; if so, please advise." It is quite obvious from inquiries of this type that there is need for a considerable amount of education in the overall "manual lifting problem." Too often, many look for a panacea, rule, or criterion of some kind, usually established by someone else, that can be applied by them so as to avoid a "total professional evaluation" of their own specific manual materials handling and lifting problems.

The subject is a very controversial one and it is still a most difficult one to comprehend by those who fail to understand the complexities involved in setting maximum lifting and carrying limits. There is no panacea or "one-shot" formula which can be validly applied as an unrestricted and unconditional safe lifting criterion.

Worldwide (manual lifting) concern

The national and international concern over this problem is evidenced by the fact that several studies of considerable scope have been completed in this area. Great Britain has for some time conducted extensive research in the area. A most comprehensive study was concluded in March 1964, in Geneva, under the auspices of the International Labor Organization (ILO), where experts from 11 countries met specifically for the purpose of attempting to establish a realistic criterion "On the Maximum Permissible Weight To Be Carried By One Worker" (the adult male and female workers, as well as children). This group will meet again in 1966 to continue Phase II of this study. This phase will deal primarily with the evaluation of reaction and review of comment received from interested parties from all over the world on the recommendations the experts presented to the ILO on setting weight lifting limits. These recommendations are described in the following paragraphs.

Setting the limits

Where operations are such that manual handling cannot be avoided, it is incumbent upon the accident preventionist and management to set realistic, "tailor-made" limits around both the person and the task. There are no simple solutions to the setting of maximum permissible weights to be carried by any one worker.

Due regard must be given to the physiological aspects of lifting and load carrying. Externally, we must give consideration to the climatic conditions, as well as the degree of training and experience each worker has had in lifting and carrying. The setting of manual lifting and carrying limits must be predicated upon, among other things, the size and type of load to be carried (compact or loose), distance of lift, height and position of the lift, the working or walking level, the incline of the surface, etc. These factors play a vital part in the development of weight limits on the load that can be lifted or carried for one time, for one day, a few days, or on a continuing and repetitive basis. The total energy expended plays a very important role in fixing limits. The fatigue factor contributes to the injury picture. There are medicophysical aspects that come into play with respect to the consumption of oxygen, pulse beat, wastes produced by muscular activity and their inadequate elimination. The effects of such accumulations may cause fatigue. Conclusions did emerge from the ILO meeting of experts on maximum permissible weights. There still remains some question with respect to the unrestricted application of tentative limits recommended by this group. The limits were set by the experts on the basis of "values obtained in the course of this research for individuals of normal constitution."

The limits set by the experts are as follows:

1. *Male worker.* To be carried by *adult male* employed in operations requiring lifting and carrying should not normally exceed 40 kilograms (82.2 pounds). *The experts agreed that the total daily load could be suitably adjusted to varying working and environmental conditions, state of nutrition and fatigue of the worker, by adjusting the number of packages and weights to be handled.*

2. *Women workers and boys.* They also agreed that the maximum permissible weight for women workers and boys aged 16–18 years should be fixed between 15 and 20 kilograms (33 and 41.1 pounds).

3. *Girls.* For girls aged 16–18, between 12 and 15 kilograms (26.4 and 33 pounds).

Department's position: caution

While many have been waiting for some time for such a criterion and the setting of permissible weight-lifting maximums by some outside expertise, the Department of Labor is somewhat reluctant to accept these limits unless they are properly surrounded by qualifications which spell out the conditions that the weights to be carried, lifted, and handled are in compact form with available means for assuming a grip on them, and that such weights should be in such a position that they can be lifted vertically, and that they are going to be lifted properly from a position below the waist level to another position below the waist level, or from a position above the waist level to another position above the waist level. The aforementioned qualifications and conditions, as well as the physical capabilities and physiological makeup of the individual worker, climatic conditions, etc., must play another vital part in the adoption and setting of the aforementioned limits. The recommended limits are not supported in their present form without the qualifications described above.

The Department's caution with respect to an unconditional adoption of the recommendations made by the experts to the ILO on lifting limits is perhaps more readily understood when one reviews some of the reservations made by the experts themselves:

• ***Nutritional problems.*** "The participants always stress the importance of the state of nutrition of the person employed to perform such work. A diet providing a sufficient amount of calories and an adequate amount of other nutrients is essential if the worker was to perform this work (maximum weight lifting) without injuring his health. The average food ration varies considerably in different parts

of the world and inevitably has repercussion on physical efficiency and muscle strength. These factors should be taken into account when fixing a maximum weight applicable to all countries."

• ***Physical conditions.*** "The physical conditions of men can vary considerably not only from one region to another but also within the same community. This factor should be taken into account in defining a maximum weight applicable internationally."

• ***Climatic conditions.*** "The climatic conditions exert a direct influence on the output of their work. It should again be stressed that a hot and humid climate often considerably reduces the amount of work which can be done."

• ***Definition of task.*** "The participants concluded that their task was to define the maximum weight of individual loads in terms of physiological capabilities, however, it was also important that normal handling operations performed during the workday should not have harmful repercussions on the worker's health. If the weight of the individual load is fixed at a suitable level the total daily amount of work *can be adapted to the environmental conditions, the worker's state of nutrition, his constitution, etc., by modifying the number of loads handled during the working period.*"

The above serves to reiterate the caution which must be exercised when attempting to set weight lifting limits.

World War II standards . . . obsolete

Manual lifting and materials handling created a very serious problem during World War II. The volume of injuries sustained from the handling of materials cut deeply into the war production effort. As a result of this, the Bureau of Labor Standards was called upon by the War Production Management Board to provide some guidance to help reduce the incidence of this type of injury. It was as a result of this effort that the Bureau developed "Special Bulletin No. 11—A Guide to the Prevention of Weight Lifting Injuries." The weight lifting limits recommended in that bulletin were intended to serve as a general guide to satisfy the needs of an emergency war production effort. With the passing of the emergency period, good safe practices dictated the need for professional evaluation of manual lifting operations and the setting of more realistic criterion on the basis of the physical capabilities of the worker as it relates to this specific manual handling task. *"Special Bulletin No. 11" mentioned above, and the weight lifting recommendations contained therein, have been declared obsolete.*

Teach them to lift

Bulletin 110, "Teach Them To Lift," has been used quite successfully as a replacement for Bulletin No. 11. It must be remembered that the basic lifting techniques, as spelled out between these covers, are only as good as their application. A periodic followup on the job by the supervisor to make certain that instructions are understood is of primary importance. Words and pictures alone do not do the job.

Demonstration model

The third section of this bulletin has been devoted to a "do-it-yourself" project containing plans and instructions on how to build a "How To Lift Model." This demonstrator was used very successfully as a school shop project by the Youth Division of the Bureau of Labor Standards. It will serve to provide a means for developing a very economical visual training aid which can be used in conjunction with the "Teach Them To Lift" instructions contained in this bulletin.

TEACH THEM HOW TO LIFT

Pick it up—put it down

From the time you cut off the alarm clock this morning, you have been picking things up and putting them down—your shoes, cup of coffee, fork loaded with scrambled eggs, the morning paper. Did you strain yourself or get a hernia? Not likely—*but* do you know that the simple process of picking up and putting down results in strains or hernias for thousands of workers every year?

At this moment, some of your workers are going through similar actions on a larger scale—picking up boxes, loaded cartons, moving lumber or pipe or metal, or in some way moving materials from one place to another. Each time they lift something, they may receive a strain or hernia if they do not use the safe method.

Here's help for you

As a foreman or supervisor, you are charged by management with seeing that your workers get out production *safely*. Here are some suggestions on how you can help them prevent injuries, such as hernias, sprains, and strains.

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The names of these injuries do not sound as final or as terrifying as *death*, but the effects of such injuries on loss of production, loss of use of workers, and physical suffering to the workers themselves are national problems which extend right into your plant and to your workers.

In the job of preventing injuries, it is not necessary to split hairs on the difference between sprains and strains. Either term may be considered as explaining a condition caused by excessive stretching or overuse of a part, possibly involving a joint or ligament. Whether a worker pulls a muscle, gets a "crick" in his back, or twists a knee, it still hurts; he may lose time from the job; and it could have been prevented by proper methods.

Lifting, carrying, or placing large or heavy objects, or using some parts or muscles too much, usually results in an injury chalked up against your department.

Why do it the hard way?

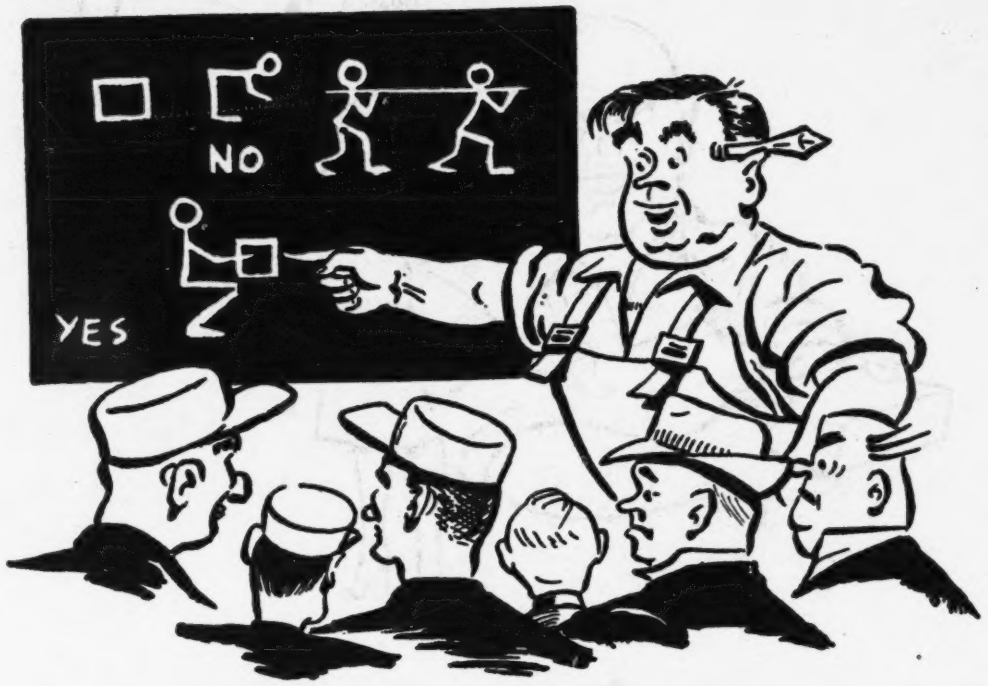
Untrained persons often do a job the hard way. As a result, they have injuries, they soon lose their pep and energy, and they take more time—which slows up production.

Lifting is one of the jobs that is more often done wrong than right. By training workers in *safe lifting* you are making an improvement in work methods beneficial to your workers and to your employers.

Get these facts in mind

Workers must be trained in safe lifting.

Most people give little or no thought to the matter of lifting until they meet some exceptional lifting problem or are injured through wrong lifting methods.



Mechanical devices promote safety where the load is great.

While mechanical aids are one solution to the prevention of injuries from handling materials, there are instances where such devices are not practical or suitable. It is well known, however, that lifting or carrying injuries can be minimized by substituting mechanical for manual lifting. Cranes, hoists, elevators, conveyors, lift trucks, and similar devices are made for this purpose. Where mechanical devices can be used, injuries to workers from lifting can be prevented.

There are limits to the weight each person can lift safely.

The physical condition, build, and stature of the individual has a lot to do with a person's ability to lift heavy objects or to work on a repetitive lifting job. Workers with known physical weaknesses (such as tendency toward hernia) should not be put on jobs where lifting is required. How much or how long a person can lift safely depends upon the person. Underweight or overweight workers or workers with deformities of the spine are especially liable to strain

from lifting. Also, arthritis, or previous injuries to joints may be aggravated by lifting. The strain of lifting is dangerous to persons with weak hearts, high blood pressure, or to those who have had lung disease.

Never overestimate the power of a woman

There also are important physical factors that must be considered as applying particularly to women. In assignment of women to jobs requiring heavy lifting or carrying, the physical ability of the individual woman should be determined not only on the basis of her weight and height but on the amount of strength she has and on her physical condition. It has been found that heavy lifting tends to aggravate menstrual difficulties, and is especially to be avoided during pregnancy. Some States have laws that limit the amount of weight that women workers may lift or carry. The regulations differ in the various States. You should become familiar with the regulations in your State. (See chart, p. C3.)

Job placement, too

The foreman should make use of all available information from physical examination records to personal discussion before assigning persons to lifting or carrying jobs.

While the carnival expert can size you up and guess your weight before you step on his scales, the same method does not work when it come to lifting. By giving a person the "once-over," you cannot determine how much he can lift safely. His capacity for work may be scaled by the amount he is required to lift and the number of times he must lift. Possibly your worker could lift a certain object several times in a day safely—but what about lifting it many times an hour all day long?

Teamwork takes practice

Where the load or material is too much for one person to handle safely, and mechanical equipment is not practical for this purpose, as many additional workers as required should be assigned to assist in the job. This brings up another problem—"teamwork." Workers of approximately the same size should be used, and they should be trained in team-lifting. If one worker lifts too soon, or shifts the load, or lowers improperly, either he or his partner may be overloaded and strained. One person should be assigned to giving orders to assure the necessary coordination.

There is a proper position for lifting heavy objects

Position and knack, or tricks of the trade, probably hold equal rank with the other factors of safe lifting. These require training and practice, and many workers, not understanding their importance, fail to realize this. Taking the proper stance and using the muscles most capable of doing the job are subjects to be stressed in your training. An example of the knack, or tricks of the trade, can be illustrated by grain workers who, by taking proper stance and grip, swing heavy sacks of grain up onto their shoulders—while inexperienced persons could barely move them.

Analyze before you start

In order to make your training most effective, take the time to analyze the lifting or carrying jobs done by each of your workers. Taking each in turn, determine:

What does he lift or carry?
How much does it weigh?
How far does he carry it?
How often does he lift or carry it?
Does he carry it up or down stairs or ramps?
Is mechanical lifting equipment provided?
Should mechanical lifting equipment be provided?
Are arrangements made for other workers to assist?

Now, from your analysis, determine which workers need instruction in safe lifting methods. It may be necessary to divide them into groups for separate instructions on lifting different materials or objects.

Call your group together for training

Keep the group small for convenient handling and clear instruction without disturbing the rest of the department. In this manner you can eventually reach every person under your supervision at your convenience. You will probably want to plan your groups so that those who do the greatest amount of manual handling will be called first.

Describe plant experiences

By checking the plant records, you probably can review several years of work injuries, among which are several important back strains, hernias, and sprains. Check the amount of lost time from work and, where possible, get estimates on the cost of medical and compensation expense. Some of these may be familiar enough to you, personally, to give a detailed account of what actually was done wrong.

Try this experiment

Place an object weighing 2 or 3 pounds on a table. Stand close to the table and raise the object to the level of your chest. Now replace the object on the table and step back a full arm's length. With your arms extended and held out straight, lift the object again to your chest

level. Feel the difference? Now you have shown a cardinal principle of good lifting—*Keep the object close to the body.*

Demonstrate the proper way to lift

Prepare in advance a 20- or 25-pound box for practicing. Use this prop to demonstrate the principles of safe lifting. There are about 10 of these principles that you can learn sufficiently to carry on a running talk during your demonstration. They are as follows:

1. Size up the load first—do not attempt to lift it alone if there is any doubt in your mind about your ability to do so.
2. Make sure that your footing is secure. Get a good balance—this means feet fairly wide apart (8 to 12 inches).
3. Place the feet close to the base of the object to be lifted. This is important because it prevents the back muscles from taking all the load.
4. Bend the knees outward and "straddle" the load somewhat, keeping the back as straight as possible.
5. Now start pushing up with your legs, using your strongest set of muscles. Keep the load close to your body as you come up, taking full advantage of the mechanical leverage your body now possesses.
6. Lift the object to the carrying position. If necessary to change your direction when in the upright position, be careful not to twist the body. Turn your body with changes of foot position.
7. If you deposit the load on a bench or table, place it on the edge to make the table take part of the load and then push it forward with the arms or, if necessary, with part of the body in a forward motion.
8. In putting the load down to the floor surface from a waist-high carrying position, bend the knees and, with a straight back and load close to the body, lower the load with the arm and leg muscles.

NOTE.—In placing your load down on the floor, first be sure that you have blocks placed to support the load—allowing room to put it down without danger to the fingers.

It all adds up to . . .

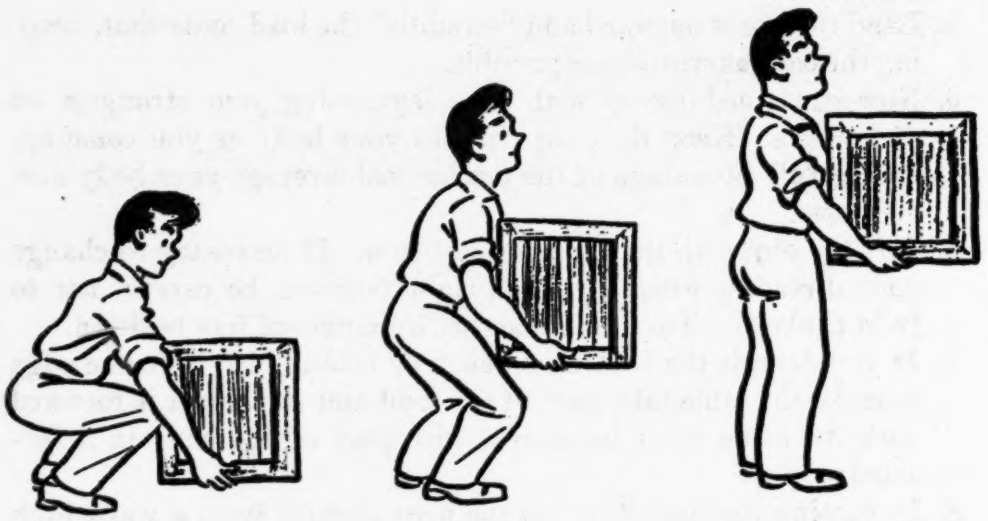
A final summary of the points you want these people to keep always in their minds when carrying materials in your department.

1. **Always carry the load close to the body.**
2. **Keep the back as straight as possible.**
3. **Lift with the leg and arm muscles.**

4. **Always have a clear vision over the load.**
5. **If the load interferes with normal walking—get help.**
6. **Never be afraid to ask for help in handling a load.**
7. **Bring in suggestions when you think some type of mechanical equipment will do a better job.**
8. **Housekeeping is important. Tripping hazards or objects on the floor can cause persons carrying a load to fall and be seriously injured.**

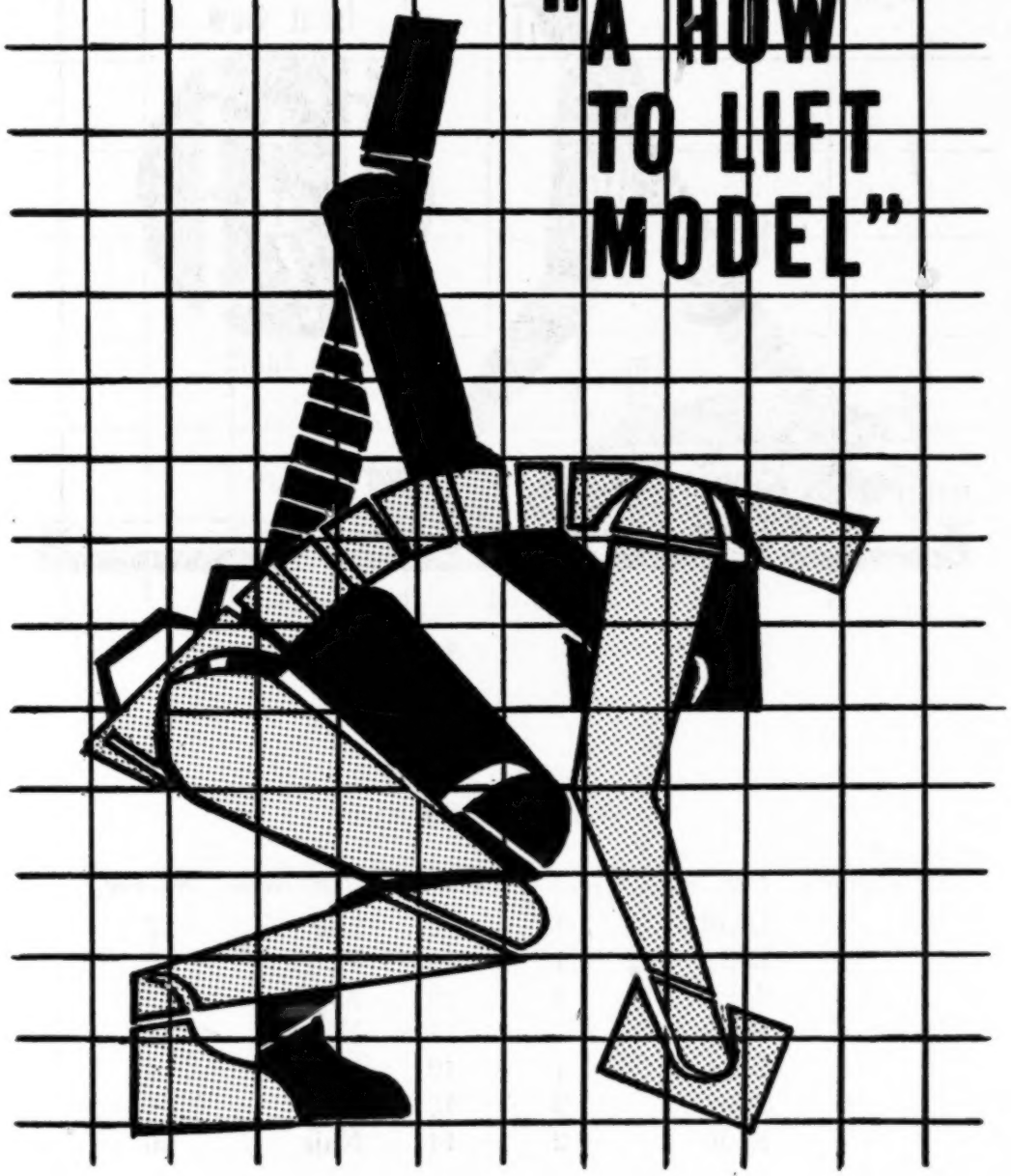
Have your workers practice proper lifting methods and remind them that the safe method should be used at *all* times.

You can make SAFE LIFTING A HABIT in your department.

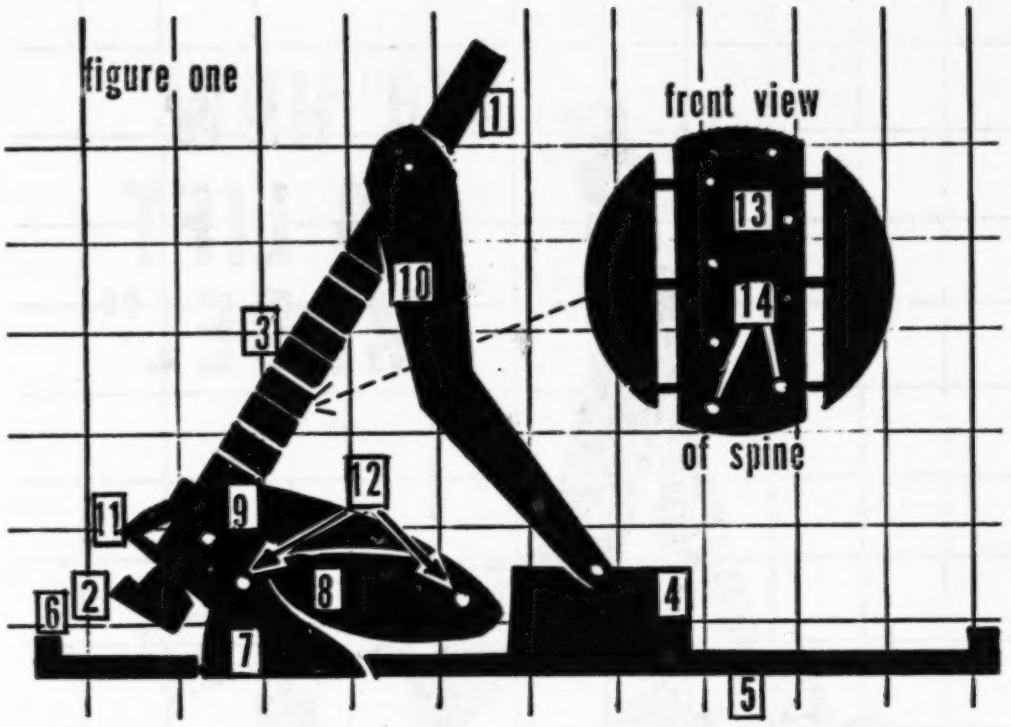


HOW TO BUILD A DEMONSTRATOR

"A HOW TO LIFT MODEL"



HOW TO BUILD IT



PARTS LIST

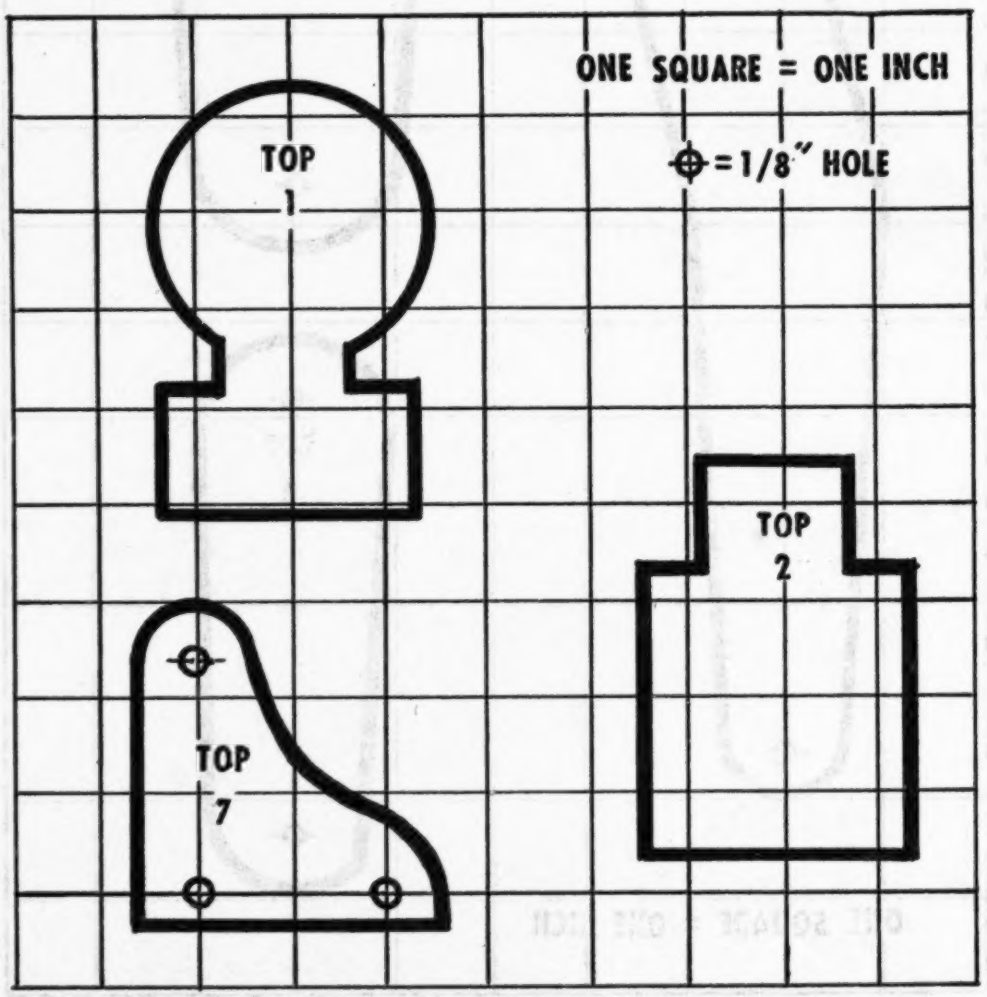
Part No.	*Part Name*	*No. Req.*	*Part No.*	*Part Name*	*No. Req.*
1	Head	1	8	Leg	2
2	Hip	1	9	Thigh	2
3	Spine	8	10	Arm	2
4	Weight	1	11	Handle	1
5	Base	1	12	Rivet	4
6	Stop	2	13	Strap	1
7	Foot	2	14	Nail	20

MATERIALS LIST

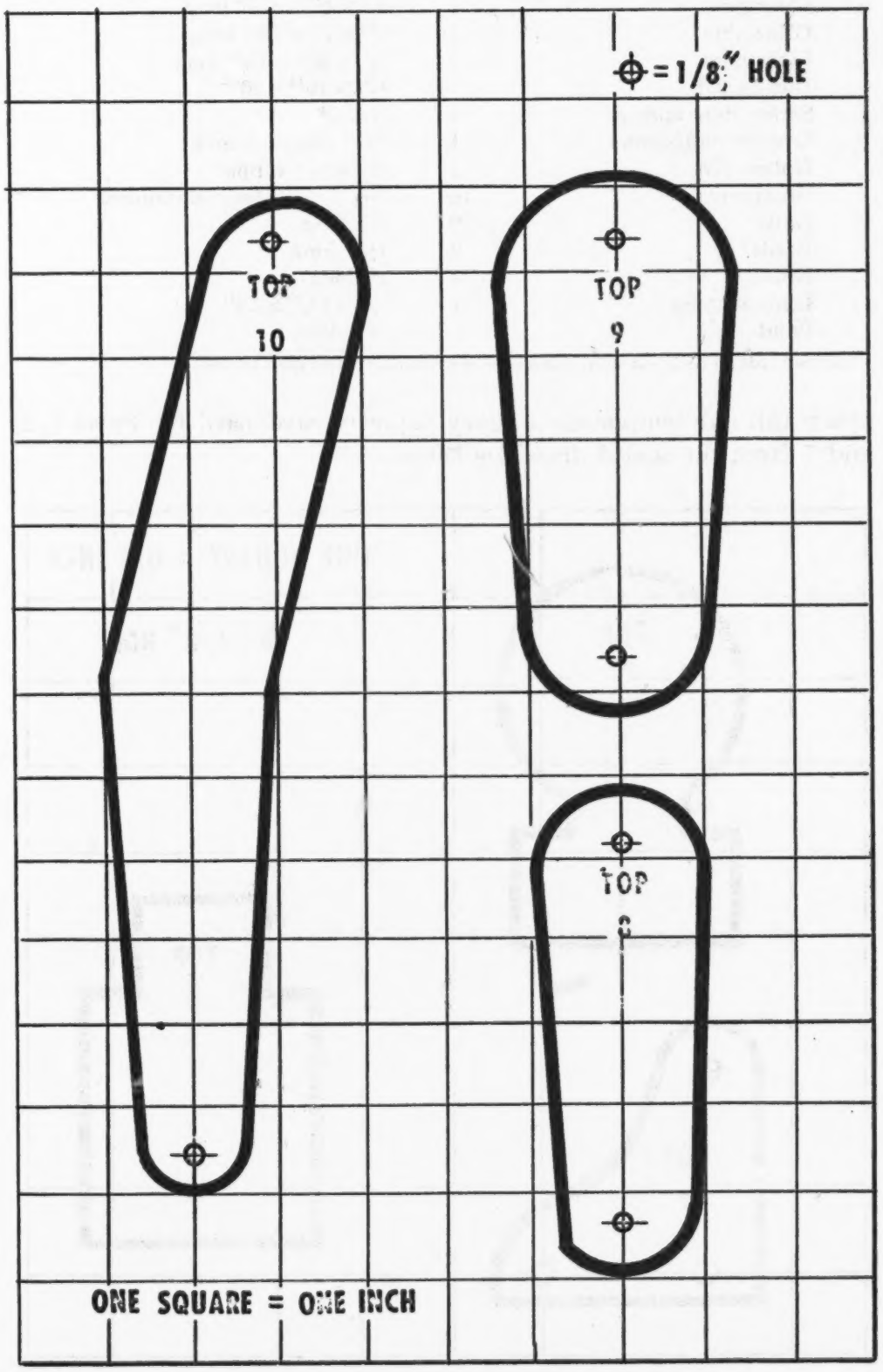
Item	*Amount needed*	*Specification*
Clear pine	1	2″×6″×12″ long
Clear pine	1	4″×4″×4½″ long
Clear pine	1	1″×4″×18″ long
Clear pine	2	½″×¾″×3½″ long
Hardboard	1	⅛″×16″×20″
Screen door spring	1	No. 4*
Drawer pull/screws	1	"C" shaped 3 inch
Hollow rivets	4	⅛″×⅝″ copper
Brass screws	10	No. 6×¾″ long roundhead
Nails	20	⅝″ long
Brads	2	1¼″ long
Brads	4	1″ long
Leather strap	1	⅛″×1¼″×10″
Paint		(4 colors)

*To insure correct operation of the spine, a No. 4 screen door spring must be used.

Draw full size templates on heavy paper or cardboard for Parts 1, 2, and 7 from the scaled drawings below.



Draw full size templates on heavy paper or cardboard for Parts 8, 9, and 10 from the scaled drawings below.



INSTRUCTIONS

Step A. *Spine:* From the 2″ x 6″ x 12″ stock cut and dress one piece to the dimension of 1½″ x 1½″ x 9″. Locate center and drill a ⅜-inch hole through the center of the 9-inch length. From this, cut eight sections, each 1-inch long. Sand and paint outer surfaces *buff* and top and bottom (containing ⅜-inch hole) *red.*

Step B. *Head and Hips:* From the remaining 2″ x 6″ x 12″ stock, using templates 1 and 2 as patterns, cut out and dress to 1½-inch thick Parts 1 and 2. In bottom center of Part 1 and top center of Part 2 drill a ⅜-inch hole to the depth of 1½ inches. Sand and paint *buff.*

Step C. *Arms and Legs:* From hardboard, using templates 7 through 10 as patterns, cut out one each of Parts 7 through 10. Reverse sides of templates and again cut out one each of Parts 7 through 10 to form opposite side. Sand edges and paint *buff.*

Step D. *Weight:* Dress surface of Part 4 to 3″ x 3″ x 4″. Paint *blue.*

Step E. *Base:* Dress surfaces of Part 5 to ¾″ x 3½″ x 18″. Nail Parts 6 to Part 5 as shown in Figure 1. Paint *black.*

Step F. Cut spring to length of 9 inches and form new eye. Insert spring 1 inch in hole in top of Part 2. Secure with 1¼-inch wire brad through eye of spring.

Step G. Thread 7 sections of Part 3 over end of spring. Expand the spring approximately 3 inches and temporarily secure in place by inserting a hacksaw blade in coil of spring at top of spine. Thread remaining section of Part 3 over the spring.

Step H. Insert spring 1 inch in hole in bottom of Part 1. Secure as in Step F above. Remove hacksaw blade.

Step I. Using Parts 14, nail Part 13 to Parts 1, 2, and 3.

Step J. Attach Part 11 to center of Part 2, as shown in Figure 1.

Step K. Using Parts 12, assemble (smooth side out) Parts 7, 8, and 9.

Step L. Attach Parts 7 to Part 5 (smooth side out) with screws so that heel is 2¾ inches from end (see Figure 1).

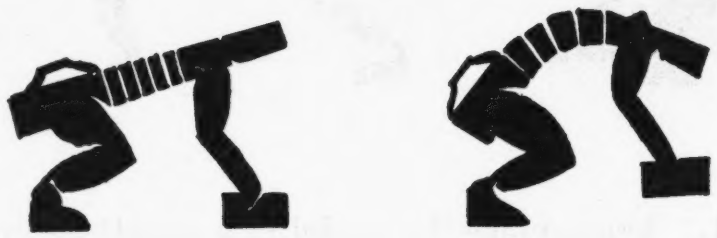
Step M. Attach Parts 9 to Part 2 at a point 2½ inches from bottom center of hips.

Step N. Attach Parts 10 (smooth side out) to center of shoulder portion of Part 1 with screws. Arms should be snug without binding.

Step O. Complete model by attaching Parts 10 to Part 4, ½ inch above center, with screws. *All joints should be snug without binding.*

HOW TO DEMONSTRATE IT

INCORRECT LIFTING

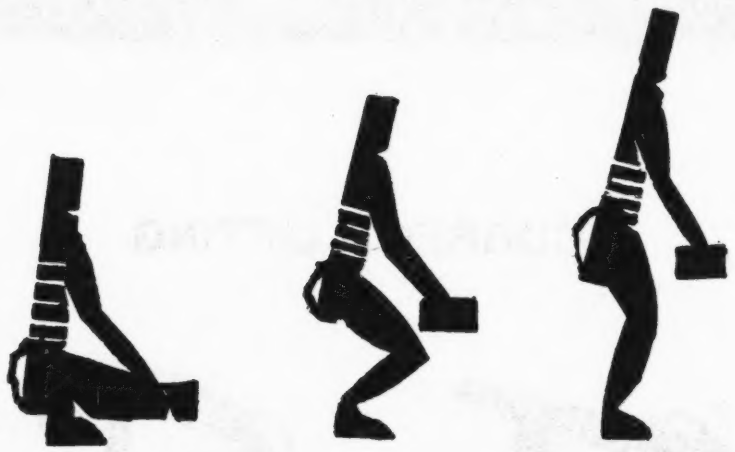


Step 1. Place the model in a squatting position, side view to the audience, with weight at the front of the base.

Step 2. Grasp handle and lift until legs are nearly straight.

Step 3. Hold the legs in this position and make model slowly lift the weight from base. Note extreme strain taking place in the lower section of the back.

CORRECT LIFTING



Step 4. Again place the model in a squatting position, but this time with the weight between the knees and the back nearly vertical.

Step 5. Grasp handle and lift, straigthening the legs, keeping the weight as near the body as possible and the back nearly vertical. Point out to the students that the spine is braced from all sides by the tensed muscles of the back and abdomen, and the lifting is done with the strong leg muscles. Returning the model to resting position, drive home the fact that if this technique of lifting is followed—even though difficult for a while—it will soon become habitual and the spine will be constantly protected from injury.

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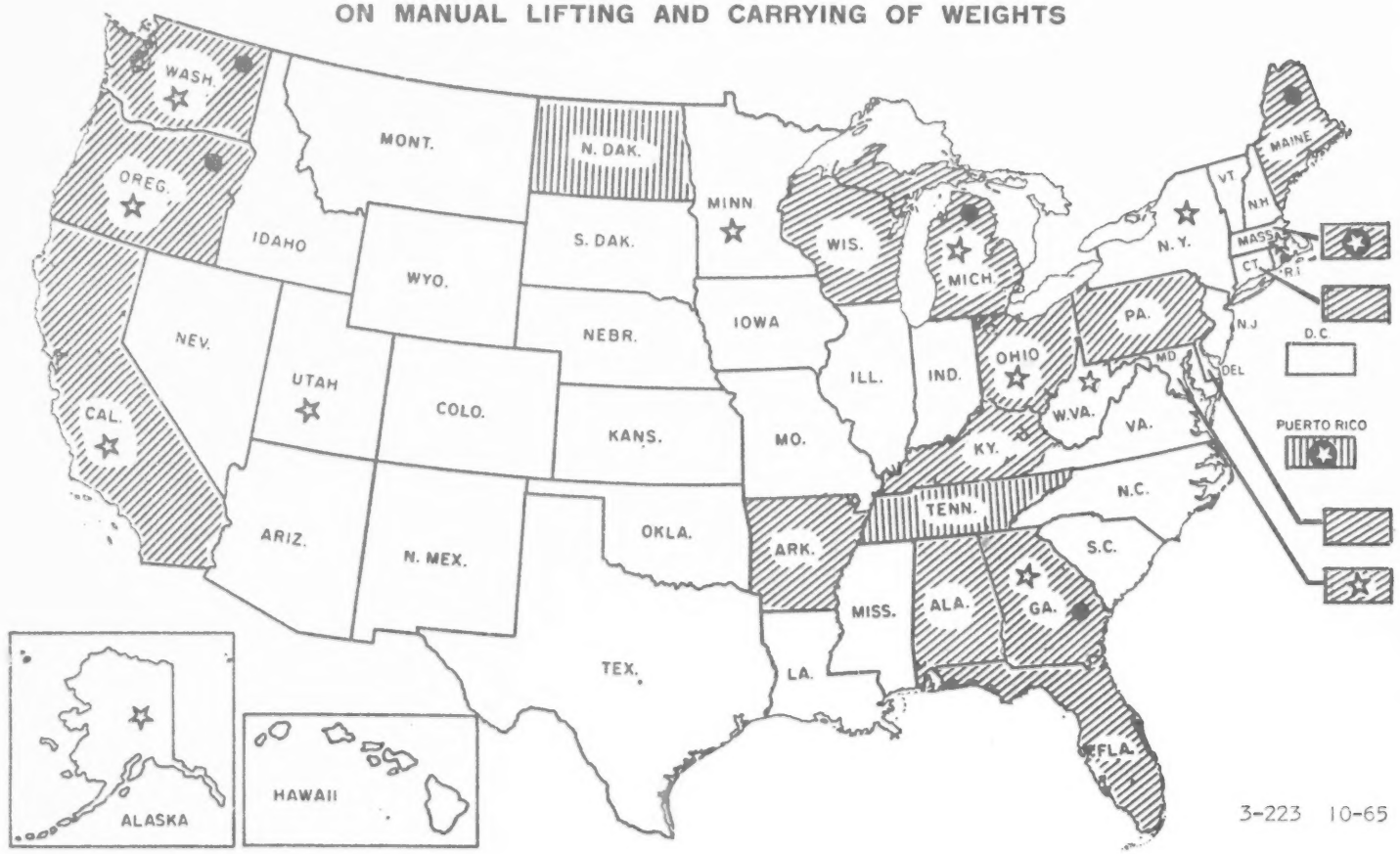
STATES WITH PROTECTION FOR WORKER ON MANUAL LIFTING AND CARRYING OF WEIGHTS



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Prohibits *minors* from engaging "in heavy work in the building trades."

Prohibits *minors* from "lifting heavy weights" (minor's age ranges from 14 to 18 years of age).

Limits amount of weight *females* may be required to lift (by weight and industry).

Prohibits *any person* from lifting heavy weights.

Protection for both men and women.